Assignment sheet 2

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Exercise 1

a)

I. M 100 → Spiral galaxy
II. NGC 4486 → Elliptical galaxy
III. NGC 1300 → Barred spiral galaxy
IV. IC 5152 → Irregular type galaxy

b) There are few differences between the images observed though different filters. The first prominent difference is the distinction in physical appearance. For instance, in the galaxy M 100, more detailed observations can be made when seen through blue filter such as star formation region, dust scattering and spiral arms. The same physical distinction applies for rest three galaxies as well.

c) The galaxies M 100, NGC 4486, NGC 1300 and IC 5152 have distinct morphological type as describe in part a which indeed corelates with their respective physical properties. The Galaxy M 100 and NGC 1300 being spiral galaxies have distinct star forming regions in their spiral arms inferring to be relatively younger galaxies. Also, the matter content is more in the bulge which decreases along towards the disc.

The elliptical galaxy NGC 4486, on the other hand seems to have regular distribution of sources in the radial direction with no particular dense region for active star formation claiming it to be a member of older Steller population. Similarly, there is no presence of disc. The luminosity, however, is greater relative to the spiral galaxies M 100 and NGC 1300.
Lastly, the galaxy IC 1512 does not seem to have any distinct geometrical outline. Although at the first glance, it appears to have the look of elliptical galaxy, upon close speculation, the claim does diminish. The image taken from blue filter provides an evidence to it. However, it does seem to have some properties such as active star formation as presented by the bright spots making it to be relatively younger stellar population.

Exercise 2

a) Approximate angular diameter through visual (a) = 6 arcmin
Approximate Distance (d) = 15 Mpc

Using small angle approximation,

Diameter D = d*a

$$D = 6\ arcmin * \frac{1\ degree}{60\ arcmin} * \frac{\pi radians}{180\ degree} * 15Mpc$$

D = 26179 pc ~ 85000 ly

No, this is not the true radius of the galaxy. The galaxy is not just made up of visible matter. There contain other forms of matter such as dark matter which extends beyond the visible extent of the galaxy. Also, there could be some low mass density regions of stars towards the outskirts of the galaxy which could easily be missed while calculating the diameter underestimating the size of M 100.

b) We have,

Apparent magnitude of galaxy M 100(m_v): 9.79
Distance (d): 15.9 Mpc
Absolute magnitude (M_v): ?

Using distance modulus relationship with apparent and absolute magnitude:

$$Mv = mv - 5log_{10}\left(\frac{d}{10pc}\right)$$

$$Mv = -22$$

c) We have,

Total flux of galaxy (F_{gal}) = Number of sources (n) * Flux of individual sources (F_*)
or, $F_{gal} = n * F_*$ ……..1

Similarly, the relationship between flux and absolute magnitude is

$$\frac{F*}{Fgal} = 100^{\frac{(mgal-m*)}{5}} \quad \text{…….2}$$

Using equation 1 in equation 2, we get,

$$\frac{1}{n} = 100^{\frac{(mgal-m*)}{5}} \quad \text{…….3}$$

Plugging all the necessary values in equation 3, we get

n = 5.24 * 10^{10} sources like sun in galaxy M 100

Also, for stars similar to Bernard's with absolute magnitude of 13.21,

n = 1.21 * 10^{14} sources